MSCI

Research Insight

Factor Indexes in Perspective

Insights from 40 Years of Data

Part I: The Study

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Executive Summary

Until recently, MSCI had calculated 25 years of simulated history for its factor indexes. A deeper history, however, can provide a richer data set, covering more market regimes, political events and market shocks. While these events will not be duplicated in the future, additional data provides a realistic framework for understanding the behavior of a given strategy or security under various conditions.

In this study, we extend the simulated history to 40 years, providing new insights into the behavior of factor indexes over various time periods. We look at factor index behavior over various time frames; the changes in the correlation between factor returns over this period; historical variations in valuation of factor indexes and their exposure to GICS sectors, to name a few.

We also use IndexMetrics, MSCI's analytical framework, to investigate various characteristics of factor indexes, such as risk, return, liquidity, investability and cost. This deeper history combined with the analytical power of IndexMetrics complements the portfolio construction tools available through Barra Portfolio Manager. Together, they help evaluate and construct equity portfolios and apply tilts to existing portfolios.

Some of the key findings of this study are:

- Factor Index performance has been persistent during the 40-year history, with increasing outperformance in the past decade.
- Sub-periods of factor underperformance can be analyzed in light of unique history, such as the Nifty Fifty collapse.
- The likelihood of factor outperformance has increased by lengthening the investment horizon.
- Combining factor indexes can reduce transaction costs by "natural crossing" of constituents from one index to another in addition to mitigating some of the cyclicality associated with factor performances.
- The 40-year history, combined with the new IndexMetrics framework, allows investors to customize factor investing strategies.

Our research just scratches the surface. Further analysis and studies may generate new insights over the behavior of factors over the past four decades.

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Forty Years of History

The Capital Asset Pricing Model relates the correlation and relative volatility, i.e., beta, of each stock to the entire market. But this single-factor model, born in 1963-64, did not explain the entire story. Why did some stocks respond to different factors in the economy? Which stocks were more sensitive to interest rates? Why did stocks in the same sector have higher correlations with each other? Starting in 1975, Barra added to investors' knowledge by decomposing stock returns into their fundamentals, employing factors commonly used by asset managers. [1]

Now, asset managers and asset owners routinely use factor analysis in understanding the performance and risks of portfolios and individual securities, as well as to test new investment hypotheses and create new models. But the data set has been limited. To date, MSCI had calculated 25 years of simulated history for its factor indexes. A deeper history provides a richer data set which covers more market regimes, political events, market shocks, etc. While these events will not be duplicated in the future, additional data provides a framework to better understand the behavior of a given strategy or security under different conditions.

In this study, we extend the simulated history to 40 years, providing new insights into the behavior of factor indexes over various time periods.[2] We also use IndexMetrics, one of MSCI's analytical tools, to investigate factor indexes with respect to various characteristics, such as risk, return, liquidity, investability and cost. This deep history of factor indexes combined with IndexMetric's analytical capabilities provide investors with new and better tools for creating and analyzing portfolios.

Our research just scratches the surface; further analysis and studies may generate new insights over the behavior of factors over the past four decades. We hope that this wealth of data will be the basis for future investigations and analysis by the investment community. In this paper, we tackle the following issues:

- Has performance from factor indexes been persistent?
- What new insights do investors glean from 40 years of factor index history?
- What can investors learn about factor indexes by delving into their characteristics?
- How can investors use this data to better create factor index-based portfolios and/or apply tilts to their existing portfolios?

Equity Factor Investing and MSCI Factor Indexes

Equity factor investing aims to capture exposures to different equity risk premia. It is strongly rooted in academic finance theory. Factor modeling and factor investing stems from CAPM of the mid-1960s, the Arbitrage Pricing Theory in the 1970s and Fama and French's three-factor model from the early 1990s. Many additional factors have been added that help explain the variation in equity returns and risks. In general, the term "factor" commonly refers to any characteristic of a group of securities that is

[1] In fact, Barra started with 39 factors, since expanded to 200 factors for the global model (GEM3)

[2] There are frequently material differences between simulated or back tested performance results and actual results. The analysis and observations in this report are limited solely to the period of the simulated historical data. Past performance -- whether actual or simulated -- is no indication or guarantee of future performance. None of the information or analysis herein is intended to constitute investment advice or a recommendation to make (or refrain from making) any kind of investment decision or asset allocation and should not be relied on as such.

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important in explaining their returns and risk. For instance, size and value are factors in the Barra model which explains some of the variations in return and risk of different stocks.

While many factors have been shown to have statistical significance in explaining variations in risk and returns, not all of these factors offer risk premia relative to CAPM pricing.[3] Risk premia factors are those which represent exposure to systematic sources of risk that have historically earned a long-term premium. We have so far identified six risk premia factors: Value, Low Size, Low Volatility, High Dividend Yield, Quality and Momentum. These factors have been empirically tested in years of academic research and there are solid explanations on why they have historically provided risk premia. From 2006 to 2013, we created seven sets of factor indexes based on these six factors (we have two indexes for the Low Volatility factor: the Minimum Volatility index and the Risk Weighted index). The High Dividend Yield index is the oldest MSCI factor index, and the Momentum index is the newest addition to the MSCI family of factor indexes.

With the introduction of each factor, we provided investors with a simulated history dating back to 1988 — some 25 years of history. We have now integrated Barra's risk-factor model into MSCI's granular security data that dates to the 1960s, providing an additional 15 years of simulated historical data. The exception is the Minimum Volatility index where we employed a proxy; the index is optimized using Barra factors which are not available for the MSCI World index prior to 1988. Detailed information for this index as well as data availability for the other factors indexes across different regions is provided in Part II, Appendix B.

Factors from the Lens of Deep History

In our previous reports, we have explained MSCI factor indexes in detail and have demonstrated how these factor indexes explain a large portion of alpha achieved by active investors.[4] These factor indexes have all been based on about 25 years of history. While 25 years provides ample data to analyze these factors and their potential pros and cons, 40 years of data allows us to see the performance of these factors in periods where they have not been tested before, e.g., the crash of 1987, the high inflationary periods of the 1970s. Forty years of history for factor indexes is unique.[5]

The Risk/Reward Chart

Sophisticated investors look at risk-adjusted returns when comparing investment opportunities. In previous reports, we have demonstrated that MSCI factor indexes have historically exhibited higher absolute returns and some have provided these returns with lower risk or volatility, compared to their parent index. Those analyses were based on 25 years of data. Do we see similar superior risk-adjusted performance when we look at these indexes in the context of 40 years of history?

The answer is that we see persistence of factor performance during the extended period. Exhibit 1(a) illustrates the relationship between risk and return for the factor indexes over the past 40 years (November 1975 to March 2014). The horizontal axis shows the annualized volatility of the index using

[3] Under CAPM, if the market is in equilibrium, there will be no risk premia and everyone owns market capitalization weightings.

[4] For more information on factor investing, see *"Foundations of Factor Investing,"* December 2013, and *"Can Alpha be Captured by Risk Premia?"* January 2013.

[5] It should be noted all the data and analyses in this report are based on gross returns and for factors based on MSCI World. The currency is USD.

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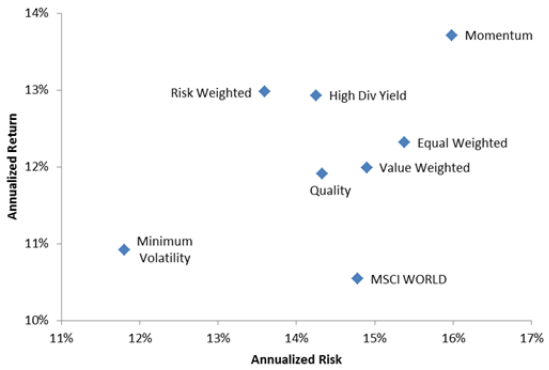
monthly returns and the vertical axis is the annualized return of the index over this period. A similar, though not identical, pattern is shown in Exhibit 1(b), which covers the 25-year period.

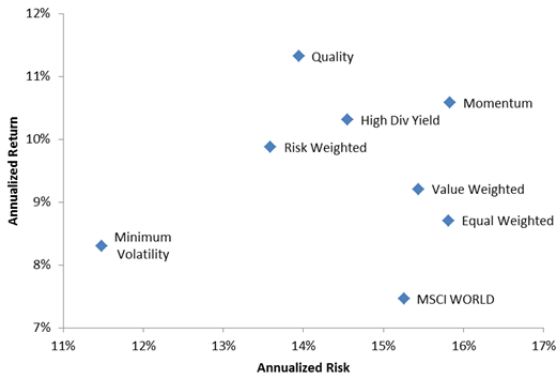
These charts show that all factor indexes have outperformed their parent index (the MSCI World index) over the 40-year horizon. Some factor indexes achieved higher performance with lower risk (e.g., Quality, High Dividend Yield, Risk Weighted and Minimum Volatility). By design, the Minimum Volatility index demonstrated the lowest volatility over this period — about 20% lower than its parent index.

Factor indexes, of course, can be built on any index universe with adequate breadth. Analyses for factor indexes based on several other major indexes, including the MSCI Europe, USA, Emerging Markets and Japan indexes can be found in Part II, Appendix A.

Exhibit 1: Performance persists over time: MSCI World and its factor indexes



(a) 40 years of history (28-Nov-1975 to 31-Mar-2014)



(b) 25 years of history (31-May-1988 to 31-Mar-2014)

Persistent long-term outperformance, with periods of underperformance

While long-term outperformance has been persistent for the 40-year period, there are sub-periods where various factor indexes have lagged their respective parent indexes. In Exhibit 2, we see that all of the factor indexes outperformed the MSCI World index over the entire period, but we also see that the Quality index experienced long but slow underperformance from 1980 to 1988. Similarly, the Risk Weighted and Equal Weighted (low size) indexes experienced shorter but much steeper underperformance during the dot-com bubble of the 1990s.

In addition, factor indexes have reacted differently and sometimes in a complete opposite direction during certain sub-periods. For example, the Momentum factor index has been negatively correlated to most other factor indexes, particularly in the run-up to the dot-com bubble's March 2000 peak. Separately, the Value and Minimum Volatility indexes show much smoother growth over time compared with the other factor indexes.

Thus, combining factor indexes over this period would have generated long-term outperformance while smoothing short-term volatility and mitigating the issue of lengthy or steep underperformance.

In the analyses that follow, besides the seven single factor indexes, we have also included two multi-factor indexes: (1) Quality Mix (which is an off-the-shelf MSCI multi-factor index) combines the Quality, Value Weighted and Minimum Volatility factor indexes, and (2) Balanced Mix, a hypothetical combination of the Equal Weighted, High Dividend Yield, Momentum, Quality, Value Weighted and

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Minimum Volatility factor indexes. Both these indexes are equally weighted and rebalanced semiannually.

Exhibit 2: MSCI factor index performance relative to the MSCI World index

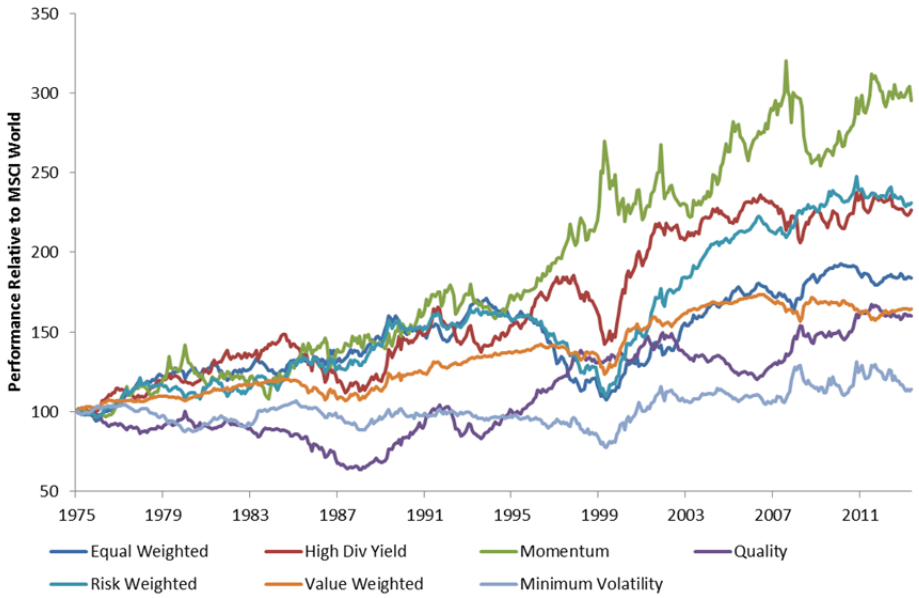

Exhibit 3 portrays how factor indexes have performed against the parent MSCI World index using various rolling time periods. We use monthly prices and look at returns on a monthly rolling basis. For instance, the first row shows how often the one-year performance of individual factor indexes has been greater than its parent index. As the length of each rolling period increases, the frequency of factor index outperformance increases. This result supports our previous results showing that factor indexes have historically provided excess returns over long periods of time. Interestingly, the MSCI Global Minimum Volatility Indexes displayed the lowest frequency of outperformance, as can be seen in Exhibit 3. However, this result is by design: The index was constructed to deliver the performance characteristics of a minimum-variance strategy, with a focus on providing absolute return and low volatility , as can be seen in Exhibit 4.

Exhibit 3: Frequency of factor indexes outperforming MSCI World index over rolling periods[6]

Rolling Window	Equal Weighted	High Div Yield	Momentum	Quality	Risk Weighted	Value Weighted	Minimum Volatility	Quality Mix	Balanced Mix
1 Y	62%	61%	66%	53%	61%	69%	46%	57%	72%
3 Y	73%	73%	77%	59%	76%	70%	52%	68%	88%
5 Y	83%	82%	91%	62%	83%	77%	55%	77%	92%
10 Y	76%	98%	99%	75%	88%	99%	65%	87%	100%
15 Y	85%	99%	100%	88%	95%	100%	66%	100%	100%
20 Y	89%	100%	100%	99%	98%	100%	72%	100%	100%
25 Y	100%	100%	100%	100%	100%	100%	91%	100%	100%

[6] Using data from 28-Nov-1975 to 31-Mar-2014 (Exhibits 3 and 4)

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Exhibit 4: Frequency of factor indexes having lower volatility than MSCI World index over rolling periods

Rolling Window	Equal Weighted	High Div Yield	Momentum	Quality	Risk Weighted	Value Weighted	Minimum Volatility	Quality Mix	Balanced Mix
1 Y	41%	61%	32%	54%	76%	49%	93%	88%	79%
3 Y	29%	68%	32%	60%	80%	56%	99%	93%	84%
5 Y	26%	67%	26%	61%	89%	67%	100%	100%	94%
10 Y	15%	80%	11%	70%	97%	80%	100%	100%	100%
15 Y	7%	100%	0%	64%	100%	78%	100%	100%	100%
20 Y	1%	100%	0%	67%	100%	74%	100%	100%	100%
25 Y	27%	100%	0%	77%	100%	66%	100%	100%	100%

Deeper History: New Insights

Using a longer data set reveals some significant differences in factor index behavior. For example, the Quality index was the best-performing factor index for the 25-year period ending 2014. Looking at the extended period of 1975-2014, the Quality index outperformed only the Minimum Volatility index. As Exhibit 2 shows, this less impressive performance is mostly due to the Quality index's nearly 12 years of underperformance from 1975 to 1987. This underperformance may stem from the aftermath of the 1973-74 collapse of the Nifty Fifty where solid earnings-growth stocks fell out of favor, followed by the Japanese equity bubble that started in 1984. The combination of these events may have hurt Quality, which tilts toward quality growth stocks. A few other examples can be seen below.

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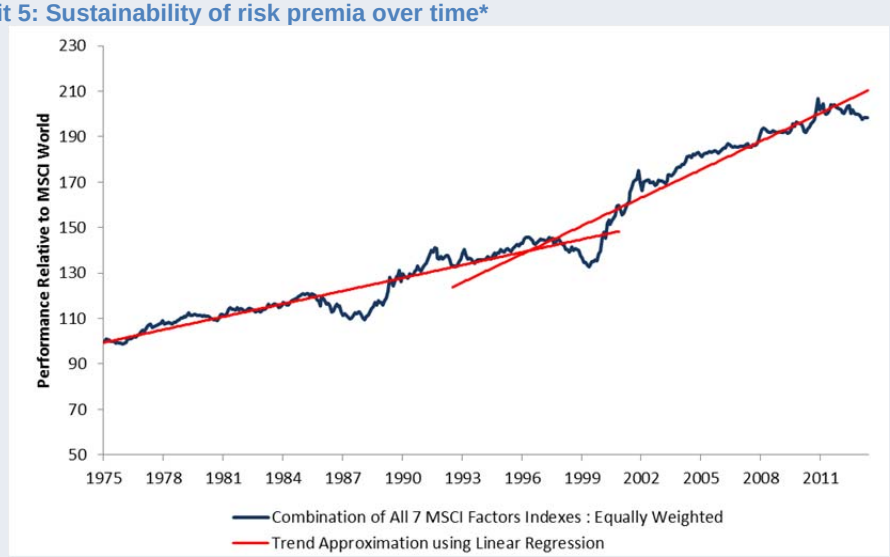
Sustainability of factor indexes. Some sources of premia are more sensitive to asset flows. For example, as more money flows into some factor index-based funds, the premium may shrink and eventually disappear. Some factor index-based funds may not have this capacity issue. However, when we examine the performance from combining all seven MSCI factor indexes on an equally weighted basis since 1975, we see that performance has not diminished over the past 40 years. If anything, one can argue that outperformance has been more pronounced over the past decade or so, which is interesting given recent inflows into factor investing.

Exhibit 5: Sustainability of risk premia over time*



Risk Weighted index vs. Minimum Volatility index. Both of these indexes are designed to capture the low volatility factor but they have distinct risk/return characteristics. The Risk Weighted index explicitly tilts towards low volatility stocks and it historically shows long-term outperformance.

On the other hand, the Minimum Volatility index, while also tending to include lower volatility stocks, takes advantage of low correlations between stocks. Thus, it can include volatile stocks with low or negative correlation to achieve minimum volatility and historically has not demonstrated sizable outperformance.

*Performance of combination of all seven MSCI factor indexes, equally weighted and rebalanced semiannually

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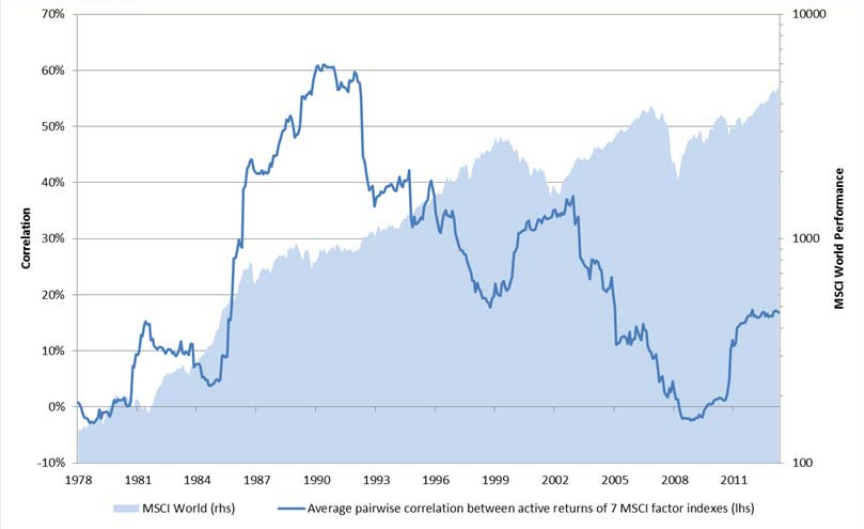
From 1975 to 2001, it has achieved virtually equal performance to its parent index with much lower volatility. Thus, the Minimum Volatility index achieved lower volatility but also weaker performance than the Risk Weighted index, as can be seen in Exhibit 6.

Exhibit 6: Historical performance of Risk Weighted and Minimum Volatility factor indexes

Correlations. Correlations among factor index returns showed a large increase starting in the mid-1980s, peaking around 1990. Since then, correlations have gradually declined, reaching zero around 2009, as can be seen in Exhibit 7. Correlations between factor index returns remained low during the recent financial crisis. These low correlations, suggest that combining multiple factors may have potential diversification effects.

Exhibit 7: Average pairwise correlation between active returns of factor indexes over time*



* using monthly returns relative to MSCI World and rolling 36-month windows

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Analyzing Factor Index Behavior: IndexMetrics

Risk and return are commonly the first parameters that an investor examines when considering an investment product, but it is only the beginning of the due diligence process. In this section, we evaluate factor indexes using IndexMetrics (IM)[7], a new analytical framework that provides insights on performance, exposure and investability in an easy to digest format. MSCI offers other analytical tools, such as Barra Portfolio Manager which offers a broad range of multi-asset class risk and performance analytics.

Performance Metrics

IndexMetrics reveals that over the past 40 years all seven MSCI factor indexes exhibited higher absolute returns compared to the MSCI World index, as can be seen in Exhibit 8. (Performance based on various periods can be seen in Exhibit 9.) These higher absolute returns were achieved with different levels of risk—in some cases, they were higher than the parent index and in some cases, lower. All MSCI World Factor indexes outperformed their parent index on both an absolute and risk-adjusted basis, with the Risk Weighted Index displaying the highest risk-adjusted return. When tracking the benchmark is more important than the absolute level of volatility, the information ratio is a critical measure.[8] Risk Weighted and Value Weighted indexes provided the strongest information ratios, while Minimum Volatility had the lowest. Exhibit 10 shows a set of risk parameters for factor indexes, both in absolute terms and in comparison with the MSCI World index.

Exhibit 8: IndexMetrics – Key Return Metrics

Historical Gross Total Return, USD	MSCI WORLD	Equal Weighted	High Div Yield	Momentum	Quality	Risk Weighted	Value Weighted	Minimum Volatility	Quality Mix	Balanced Mix
Total Return* (%)	10.7	12.5	13.2	13.8	12.1	13.2	12.2	11.1	11.9	12.6
Total Risk* (%)	14.8	15.4	14.2	16.0	14.3	13.6	14.9	11.8	13.2	13.7
Return/Risk	0.72	0.81	0.93	0.87	0.84	0.97	0.82	0.94	0.90	0.92
Active Return* (%)	0.0	1.8	2.4	3.2	1.4	2.4	1.4	0.4	1.2	1.9
Tracking error* (%)	0.0	5.0	6.2	8.2	5.8	5.4	3.4	5.9	3.4	3.0
Information Ratio	NA	0.35	0.38	0.38	0.24	0.45	0.43	0.06	0.35	0.62
Historical Beta	1.00	0.98	0.88	0.93	0.89	0.86	0.98	0.74	0.87	0.91
Turnover** (%)	1.8	18.4	25.4	95.9	27.2	23.6	17.2	22.7	20.0	29.0
Price to Book***	1.9	1.4	1.6	2.5	3.1	1.5	1.4	1.9	1.9	1.8
Price to Earnings***	15.3	15.7	10.7	17.7	13.6	14.9	13.1	14.9	13.8	13.9
Div. Yield*** (%)	2.9	3.0	5.0	2.2	2.8	3.3	3.5	3.4	3.2	3.3

* Annualized in USD from 28-Nov-1975 to 31-Mar-2014

** Average annual one-way index turnover from 28-Nov-1975 to 31-Mar-2014

*** Average value from 28-Nov-1975 to 31-Mar-2014

Exhibit 9: IndexMetrics – Absolute Performance to Date

Performance *	MSCI WORLD	Equal Weighted	High Div Yield	Momentum	Quality	Risk Weighted	Value Weighted	Minimum Volatility	Quality Mix	Balanced Mix
YTD	1.4%	1.9%	2.8%	0.0%	0.8%	2.3%	1.6%	2.3%	1.6%	1.3%
1 Yr	19.7%	19.1%	16.2%	17.6%	19.3%	15.1%	22.0%	8.3%	16.6%	16.5%
3 Yr **	10.9%	9.4%	12.2%	13.8%	14.3%	10.6%	10.1%	11.7%	12.2%	11.8%
5 Yr **	18.9%	20.5%	21.0%	19.3%	20.0%	19.6%	19.8%	16.9%	19.0%	19.6%
10 Yr **	7.4%	8.9%	8.2%	10.0%	9.5%	9.4%	7.4%	8.0%	8.4%	8.6%
15 Yr **	4.7%	8.1%	6.7%	6.9%	5.8%	9.1%	6.1%	6.6%	6.3%	6.7%
20 Yr **	7.6%	8.1%	10.1%	10.7%	11.1%	9.5%	8.8%	8.5%	9.5%	9.6%
25 Yr **	7.1%	8.3%	10.1%	10.2%	11.0%	9.5%	8.9%	8.1%	9.5%	9.6%
30 Yr **	9.9%	11.2%	11.9%	13.3%	12.3%	12.3%	11.2%	10.4%	11.4%	11.9%
35 Yr **	10.4%	11.8%	12.6%	13.5%	12.3%	12.6%	11.8%	10.8%	11.7%	12.3%

* Gross Total Returns in USD for period ending 31-Mar-2014

** Annualized

[7] For more details about the tool and framework please see *"Introducing MSCI IndexMetrics: An Analytical Framework for Factor Investing,"* December 2013

[8] The information ratio is calculated by dividing the active return (factor index return minus benchmark return) by the tracking error (a measure of deviation from the parent index); it captures the amount of returns achieved by a unit of risk or deviation from the parent index.

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Exhibit 10: IndexMetrics – Key Risk Metrics

Statistics from 28/11/1975 to 31/03/2014	MSCI WORLD	Equal Weighted	High Div Yield	Momentum	Quality	Risk Weighted	Value Weighted	Minimum Volatility	Quality Mix	Balanced Mix
Total Risk* (%)	14.8	15.4	14.2	16.0	14.3	13.6	14.9	11.8	13.2	13.7
Ann. Downside Deviation (%)	9.6	10.0	9.1	9.9	9.1	8.8	9.6	7.4	8.4	8.8
Sortino ratio	1.11	1.24	1.45	1.39	1.33	1.50	1.26	1.50	1.41	1.43
95 percentile Var (%)	-6.6	-6.5	-5.2	-6.8	-6.1	-5.3	-6.1	-4.7	-5.5	-5.7
99 percentile Var (%)	-10.9	-12.2	-12.0	-13.0	-10.8	-10.3	-11.8	-9.3	-9.9	-11.2
Expected Shortfall @ 95%	-9.8	-10.5	-9.7	-9.8	-9.1	-9.3	-10.1	-7.5	-8.7	-9.2
Expected Shortfall @ 99%	-14.4	-16.4	-15.3	-14.8	-14.2	-14.7	-15.2	-12.1	-13.5	-14.5
Max Drawdown (%)	53.7	54.8	58.8	52.6	44.5	50.9	57.3	43.1	48.5	52.6
Max Drawdown period (in months)	16	16	16	16	16	16	16	16	16	16
Skewness	-0.64	-0.84	-0.80	-0.45	-0.66	-1.00	-0.73	-0.69	-0.78	-0.86
Kurtosis	4.71	6.07	6.04	4.15	5.19	6.77	5.67	5.73	5.66	5.73
Relative Risk Metrics										
Tracking error* (%)		5.0	6.2	8.2	5.8	5.4	3.4	5.9	3.4	3.0
Max Drawdown of Active Returns (%)		38.1	25.1	24.0	37.1	34.9	13.8	31.7	18.5	10.6
Number of years of underperformance		15	17	12	19	14	12	21	17	12
Max consecutive years of underperformance		5	4	2	4	3	3	4	3	3

* Annualized in USD from 28-Nov-1975 to 31-Mar-2014

Valuations

IndexMetrics also offers important valuation metrics. Looking at how these parameters change over the 40-year history can be helpful in explaining under- or out- performance for each index during selected time periods. These metrics also help investors to relate the current environment to historical norms and aid them in designing their investment strategies. Exhibit 11 shows a standard report for the parameters for the MSCI World index and its associated factor indexes from 1975 to 2014; other metrics are available.

Exhibit 11: IndexMetrics report output – Key Ratios

Statistics from 28/11/1975 to 31/03/2014	MSCI WORLD	Equal Weighted	High Div Yield	Momentum	Quality	Risk Weighted	Value Weighted	Minimum Volatility	Quality Mix	Balanced Mix
Price to Book	1.9	1.4	1.6	2.5	3.1	1.5	1.4	1.9	1.9	1.8
Price to Cash Earnings	7.9	7.0	6.1	9.3	9.4	6.9	6.2	7.6	7.6	7.4
Price to Earnings	15.3	15.7	10.7	17.7	13.6	14.9	13.1	14.9	13.8	13.9
Div. Yield (%)	2.9	3.0	5.0	2.2	2.8	3.3	3.5	3.4	3.2	3.3

Average values from 28-Nov-1975 to 31-Mar-2014

Exhibit 12 illustrates the range of key parameters for all MSCI factor and multi-factor indexes. The charts compare current levels of these parameters to the historical average (November 1975 to March 2014), extremes and 10-90 percentile levels. These types of analysis and data can be very useful tools in selecting combinations of factors as a strategic overlay to the equity portfolio or for tactical rotation between factors over time.

Exhibit 12: Historical statistics for selected fundamental parameters[9]

[9] Using data from 28-Nov-1975 to 31-Mar-2014

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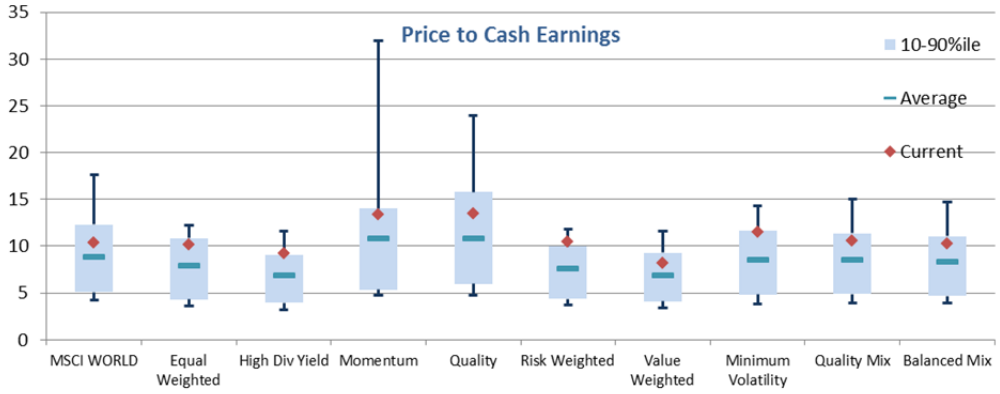

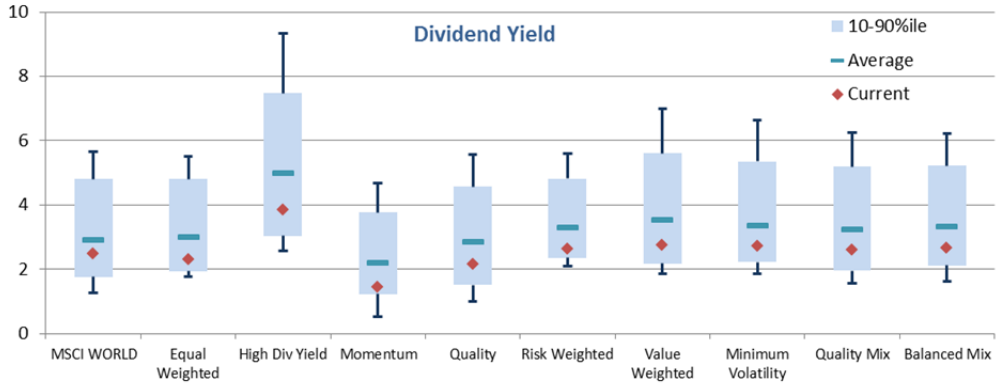

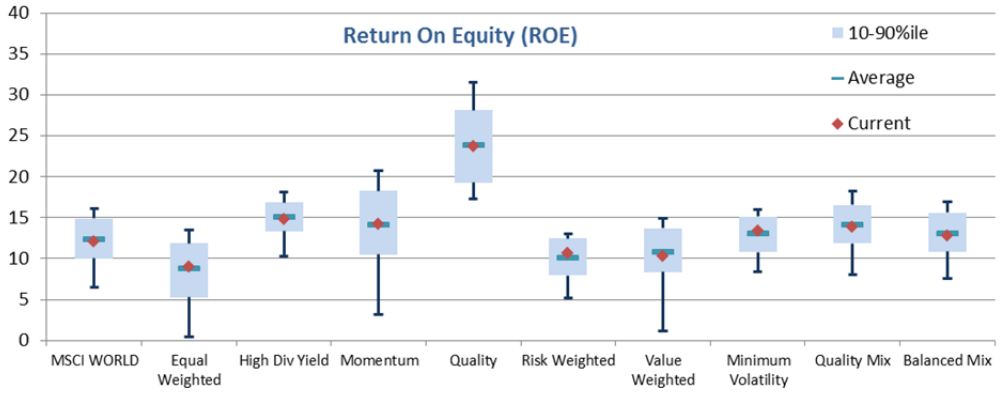

Exposures

Similar to valuations, exposures to specific sectors, fundamental factors or countries provide valuable insight into better understanding each factor index. IndexMetrics compares the current values to the average and historical ranges, providing insight into each factor index's behavior over time.

Exhibits 13-15 show the active exposures of Momentum, Quality and Value Weighted Indexes to the 10 top level GICS sectors during the period from 31-May-1994 to 31-Mar-2014. The red diamonds show the current levels, the blue lines show the historical average and the bars shows the historical range.

Momentum tends to show strong rotation between sectors during this period. The strong bias is clear from the current levels of exposures and also from the wide range of exposures historically. On average, however, we can see that active exposures have been around zero, highlighting that Momentum utilizes all sectors.

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The ranges of active exposures for Quality and especially Value Weighted factors were much tighter during this period. The Value Weighted index did not present much active sector bias, displaying narrow bands around zero. The Quality index was overweight in Consumer Staples and Healthcare and underweight Financials and Utilities.

Similar sets of data and charts are available in IndexMetrics illustrating country exposures as well as style factor exposures, based on Barra factor models.

Exhibit 13: Historical active exposure of Momentum index to GICS sectors[10]

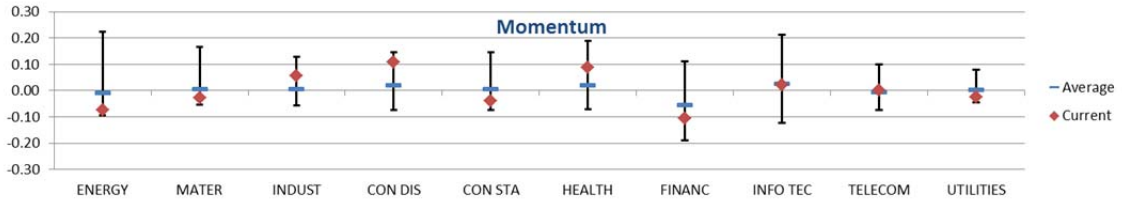

Exhibit 14: Historical active exposure of Quality index to GICS sectors

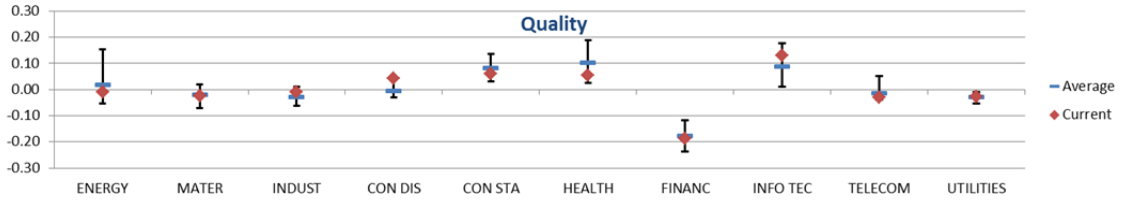

Exhibit 15: Historical active exposure of Value Weighted index to GICS sectors

Investability

Factor indexes should not only be logical, rules-based and transparent, but they also must be investable to serve as the basis for index-tracking financial products. In developing the MSCI factor indexes, parameters such as turnover, capacity and liquidity were key design elements.

While MSCI factor indexes have been designed to be replicated by investable and high capacity index-tracking funds, they are not intended to be a replacement for market cap indexes. Market cap index funds by definition and construction provide infinite capacity and are best representative of the equity market as a whole.

To help investors better understand the capacity and other investability issues around replicating factor indexes, we have identified a set of parameters and have standardized them in the IndexMetrics tool. Exhibits 16 and 17 show these parameters for hypothetical funds tracking the MSCI World factor indexes and compare them with the parent market cap weighted index. Exhibit 16 provides a measure of concentration of each hypothetical factor index fund by displaying the effective number[11] of stocks as

[10] Active GICS sector exposures are computed from 31-May-1994 to 31-Mar-2014 (Exhibits 13-15)

[11] The definition of the effective number of stocks and other parameters used can be found in Part II, Appendix C.

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well as providing parameters to show the capacity, such as the average ownership of stocks if $1 billion is invested in an index-tracking fund. A detailed explanation of each parameter is provided in Part II, Appendix B.

Looking at the "Concentration Metrics" section of the table, we see that factor indexes such as Value Weighted, Risk Weighted and Equal Weighted tilt away from market cap index exposures but retained all the constituents of the parent index during this period. On the other hand, factor indexes such as Minimum Volatility, Quality, Momentum and High Dividend Yield, which include stocks based on their exposure to the desired factor rather than reweighting the parent index, had a more concentrated composition, covering 20%-50% of the constituents of the MSCI World parent index. These differing levels of concentrations directly affect the "Degree of Index Tilt" parameters shown in the bottom section of the table.

The "Capacity of the Strategy" section provides metrics to measure and compare investment in hypothetical funds tracking each factor index to funds based on the parent market cap index. For instance, an investor investing $1 billion in a fund tracking the Minimum Volatility index will hold, on average, 0.005% of each stock. These numbers become more meaningful as the size of the investment grows and for more concentrated universes. For instance, the capacity that MSCI ACWI or MSCI World factor index-based funds offer is much larger than the capacity available in regional or country factor indexes.

Exhibit 16: IndexMetrics: Capacity & Concentration Metrics[12]

Statistics from 28Nov1975 to 31Mar2014	MSCI WORLD	Equal Weighted	High Div Yield	Momentum	Quality	Risk Weighted	Value Weighted	Minimum Volatility	Quality Mix	Balanced Mix
Concentration Metrics *										
Avg No of Stocks	1437	1,437	359	278	297	1,435	1,437	270	1,436	1,436
Effective No of Stocks	276	1,420	86	75	71	982	294	114	187	277
Market Cap coverage (%)		100.0	27.9	23.6	32.7	100.0	100.0	46.0	100.0	100.0
Top 10 Sec wt (%)	13.0	0.7	26.4	28.8	29.1	3.2	12.8	19.3	16.8	13.2
Capacity of the Strategy (@ USD 1 bn) **										
Stock Ownership (% of Float Market Cap)										
Average		0.010%	0.002%	0.003%	0.002%	0.009%	0.004%	0.005%	0.004%	0.005%
95 percentile		0.029%	0.013%	0.017%	0.012%	0.029%	0.008%	0.055%	0.021%	0.014%
Tail Average @ 95%		0.038%	0.013%	0.021%	0.014%	0.042%	0.011%	0.064%	0.024%	0.017%
Maximum		0.074%	0.013%	0.026%	0.017%	0.168%	0.057%	0.066%	0.029%	0.023%
Stock Ownership (% of Full Market Cap)										
Average		0.007%	0.002%	0.003%	0.002%	0.007%	0.003%	0.004%	0.003%	0.003%
95 percentile		0.020%	0.013%	0.015%	0.011%	0.020%	0.006%	0.035%	0.014%	0.010%
Tail Average @ 95%		0.024%	0.013%	0.018%	0.013%	0.028%	0.009%	0.050%	0.019%	0.013%
Maximum		0.034%	0.013%	0.025%	0.017%	0.076%	0.057%	0.065%	0.027%	0.018%
Degree of Index Tilt *										
Active Share (%) **	0.0	46.7	74.7	77.7	71.2	46.5	22.8	77.3	38.5	29.6
Avg Weight Multiplier	1	6	4	5	3	6	1	6	2	2
Max Weight Multiplier	1	199	4	9	5	154	31	17	13	36
Max Strategy Weight (%)	2.4	0.1	4.4	4.8	4.7	0.4	2.4	4.3	3.3	2.3

* Average values from 28-Nov-1975 to 31-Mar-2014
** As of 02-Dec-2013 rebalancing

It is difficult to represent the liquidity of a stock or portfolio of stocks in a single number. Exhibit 17 presents a set of relevant parameters to help investors get a sense of liquidity from various angles. The Annual Traded Value Ratio (ATVR) of a security–measuring the ratio of volume traded in a year as a percentage of market capitalization–is a weighted average and used as one of the main measures of liquidity. This metric demonstrates that less concentrated factor indexes such as Equal or Value Weighted tended to have better average liquidity.

[12] For hypothetical funds tracking factor indexes

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Turnover and the approximate cost associated with the turnover is presented assuming different levels of transaction costs, providing a proxy for the cost of replication. As one expects, the market cap weighted parent index shows very low turnover (here 1.8% average annualized one-way turnover between 1975 and 2014). Factor index-based funds all demonstrated higher levels of turnover.

Most MSCI factor indexes are rebalanced semiannually. The exceptions are the Equal Weighted index which is rebalanced quarterly in order to minimize deviation from the desired factor and the Momentum index which, in addition to semiannual rebalancing, is rebalanced on an ad hoc basis over the year to avoid missing inflection points. As a result, the Momentum index demonstrates a much higher turnover and consequently higher replication costs compared to other factors.

Exhibit 17: IndexMetrics: Liquidity Metrics and Cost of Replication[13]

Statistics from 28/11/1975 to 31/03/2014	MSCI WORLD	Equal Weighted	High Div Yield	Momentum	Quality	Risk Weighted	Value Weighted	Minimum Volatility	Quality Mix	Balanced Mix
Tradability of the Strategy (@ USD 1 bn / 10% of daily trading vol.)										
Weighted Average ATVR (%)		95.3	49.3	79.2	45.0	72.8	74.4	50.6	57.0	69.2
Days to Trade - Periodic Rebalancing *										
Weighted Average		0.1	0.5	0.7	0.5	0.2	0.1	1.0	0.2	0.1
95 percentile		0.2	0.1	0.8	0.1	0.2	0.1	0.2	0.1	0.1
Tail Average @ 95%		0.3	0.4	1.0	0.4	0.4	0.1	0.9	0.3	0.2
Maximum		1.6	2.0	2.5	1.3	2.2	0.9	3.9	1.1	0.5
Days to complete 95% trading		0.4	1.0	1.5	1.0	0.6	0.2	2.5	0.6	0.2
Days to Trade - Relative to Parent Index **										
Weighted Average		0.3	0.7	0.7	0.6	0.4	0.1	2.0	0.4	0.2
95 percentile		0.8	0.9	1.1	0.9	1.1	0.2	4.6	0.7	0.4
Tail Average @ 95%		1.3	1.1	1.4	1.0	1.9	0.3	5.9	1.1	0.7
Maximum		4.0	1.9	1.7	1.6	13.3	2.4	9.1	3.1	1.9
Days to complete 95% trading		0.8	1.2	1.2	1.0	1.5	0.3	3.9	7.9	7.9
Days to Trade - Relative to Cash **										
Weighted Average		0.4	0.9	0.9	0.9	0.5	0.2	2.0	0.5	0.3
95 percentile		1.0	0.8	0.9	0.8	1.3	0.4	1.9	0.8	0.6
Tail Average @ 95%		1.5	1.1	1.2	1.1	2.1	0.5	3.5	1.4	0.9
Maximum		4.3	2.6	2.1	2.1	13.6	2.5	9.6	3.6	2.4
Days to complete 95% trading		1.0	1.6	1.7	1.3	1.8	0.6	4.8	1.3	0.8
Replication Costs										
Turnover*** (%)	1.8	18.4	25.4	95.9	27.2	23.6	17.2	22.7	20.0	29.0
Performance Drag in bps (at 25 bps)	0.9	9.2	12.7	48.0	13.6	11.8	8.6	11.4	10.0	14.5
Performance Drag in bps (at 50 bps)	1.8	18.4	25.4	95.9	27.2	23.6	17.2	22.7	20.0	29.0
Performance Drag in bps (at 75 bps)	2.7	27.6	38.1	143.9	40.8	35.4	25.9	34.1	30.0	43.4

* Average of last four rebalancings ending Dec-2013

** As of 02-Dec-2013 rebalancing

*** Average annual one-way index turnover from 28-Nov-1975 to 31-Mar-2014

Multi-Factor Indexes

Factor indexes have demonstrated historical risk premia and long-term outperformance[14] compared to their market cap weighted parent indexes over the period analyzed. Investors could choose any of the factor indexes as a strategic overlay to their passive market cap investments or rotate in and out of different factor index-based funds, based on timing decisions and their view of the market. However, the cyclical nature of these factors can create a long drag on the performance of a portfolio. As was shown in Exhibit 2, factors have separate drivers and have been subject to different performance cycles. This historical variation in performance may prompt investors to consider combining different factors to create smoother performance characteristics.

Exhibit 18, a standard output of IndexMetrics, demonstrates the correlation between the factor indexes. The low correlations between factors suggest that selectively combining factor indexes could have

[13] For hypothetical funds tracking factor indexes

[14] Past performance is not a predictor of future portfolio returns.

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reduced the overall volatility of the combined index during this period. In addition, given the positive active return to all factor indexes, their combination would have maintained the positive active returns and therefore could have improved the Sharpe ratio of the strategy compared to the average of its single factor index building blocks.

Investing in funds based on multiple factors can be done by investing in the individual factor index-based funds separately or can be done by investing in a multi-factor index fund. A portfolio tracking a multi-factor index may experience less turnover and lower transaction costs as a result of internal crossing.

Exhibit 18: Long-term correlation between factor indexes using monthly active returns

	Equal Weighted	High Div Yield	Momentum	Quality	Risk Weighted	Value Weighted	Minimum Volatility
Equal Weighted	1.00						
High Div Yield	0.26	1.00					
Momentum	-0.11	-0.03	1.00				
Quality	-0.17	0.41	0.22	1.00			
Risk Weighted	0.81	0.49	0.01	0.01	1.00		
Value Weighted	0.56	0.73	-0.32	0.14	0.52	1.00	
Minimum Volatility	0.13	0.45	0.08	0.19	0.58	0.16	1.00

Based on monthly returns relative to MSCI World for the 28-Nov-1975 to 31-Mar-2014

Designing Multi-Factor Indexes

Designing a multi-factor index and incorporating it into the equity allocation starts with investors' investment beliefs. Investment beliefs shape the selection of factors to include. IndexMetrics can be used iteratively to fine tune the combination and weightings of selected factors. This process can be replicated for any MSCI index (global, regional, country, ESG or even most custom indexes).

With six factors (and seven factor indexes) available and different possible weightings of each index within a multi-factor index, there are many possible combinations. MSCI offers the Quality Mix index as an off-the-shelf multi-factor index but investors can also design customized multi-factor indexes.

Quality Mix

The MSCI Quality Mix index is an equally weighted combination of the Quality, Value Weighted and Minimum Volatility indexes. The weight of each factor in the index is reset to one-third of the combined index on each semiannual rebalancing date. Exhibit 18 shows the Value Weighted index has a low correlation to both the Quality and Minimum Volatility indexes. Exhibit 19 reveals that the combined index has been less volatile over time compared with the underlying single-factor indexes.

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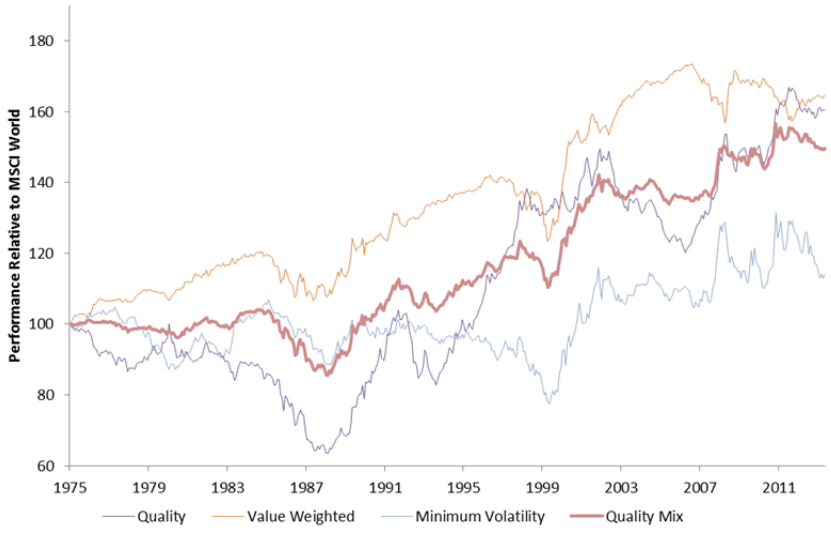
Exhibit 19: Historical performance of Quality Mix and its underlying factor indexes relative to MSCI World

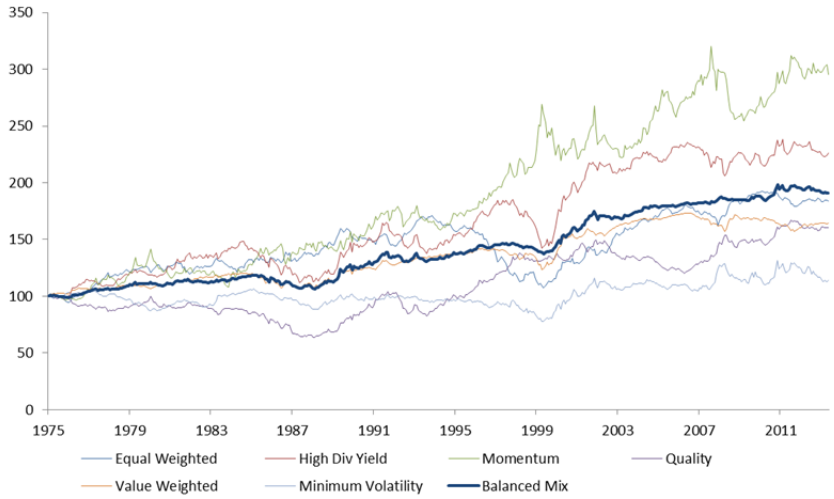


Balanced Mix

The MSCI Balanced Mix index is a hypothetical mixture of the six current MSCI factors indexes: Value, Momentum, Equal Weighted, Quality, High Dividend Yield and Minimum Volatility, equally weighted and rebalanced to equal weights semiannually. Exhibit 20 demonstrates the consistent outperformance of the index and its underlying factors over a long horizon.

This simple combination takes most of the timing/selection concerns out of the investment decision by using all the factors. The Balanced Mix demonstrated a smooth outperformance over time with relatively short and shallow drawdown periods when compared to single factor indexes (see Exhibit 10). It also exhibited lower tracking error to the parent index and a considerably higher information ratio when compared to single factor indexes (see Exhibit 8).

Exhibit 20: Historical performance of Balanced Mix and its underlying factor indexes relative to MSCI World



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Customized Factor and Multi-Factor Indexes

Multi-factor indexes also can be customized in two ways. The more straightforward method is to create a multi-factor index using standard available factor indexes and applying investors' desired weightings (e.g., Balanced Mix discussed above). The second option is to take any of the factor methodologies and apply it to an index that does not have standard factor indexes. This can be a bespoke index itself (e.g., MSCI Europe ex UK ex France + Canada) or any available MSCI index (e.g., MSCI World ESG).

Conclusion

Forty years of simulated historical data provides investors greater insight into the behavior and characteristics of factor indexes. One major insight is that risk-adjusted performance has not only been consistent, but has actually increased over the past ten years. Other insights relate to the underlying indexes and how they behave individually and in combination with each other. From the IndexMetrics tool, we obtain a deeper understanding of these indexes beyond simple risk and return parameters, providing far more detail on issues such as performance, valuations, exposures and investability. For investors, this deeper history combined with the analytical power of IndexMetrics complements the portfolio construction tools available through Barra Portfolio Manager. Together, they help evaluate and construct equity portfolios and apply tilts to existing portfolios. For researchers, 40 years of history opens up a deeper and more valuable vein to mine as they explore financial market patterns and behavior.

The authors thank Joel Chernoff for his editing assistance and for his invaluable contributions to this report.

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[1]*As of March 31, 2014, as reported on June 25, 2014, by eVestment, Lipper and Bloomberg*

September 2014

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